Water Pumping for Livestock Using Photovoltaic Power Systems

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Who is Northwest Rural Public Power District?

- Provides electrical power, financing, other services to Northwest Nebraska
- 2186 miles of line with 1.35 customers/mile
- New *revenue* streams attractive
  - .6% growth in electric income
  - 2-3% escalation in cost
- Serves 4000 square miles/5 different terrains

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Wooded Hills

Open Pastures

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PV Water Pumping for Livestock *as a Business*

- Site specific
- Not replace grid
- Sound addition to co-ops line extension and line replacement program
- Cost effective when used properly
- Asset when co-ops guide its use

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What Is Needed?
Partnerships

Customer - Utility

Partners, Not Adversaries

- Off-Grid
  - Line Extension/Prevention
  - Save Fuel (Oil & Gas)
- Grid-Tied
  - Save Fuel (Oil & Gas)
  - Avoided Cost
    - Distribution Line
    - G&T
    - Coal (1 Cent)
- Partnership Opportunity
  - Minimize or Prevent
    - Distribution Upgrades
    - Generation Needs
    - Peak Power Purchases
  - Volume Required for Potential Savings
  - O&M Support

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PV Water Pumping for Livestock *as a Business*

- Need to be proactive to address PV community concerns on utility acceptance
- Application problems can be solved
- Negative effects to not engage

Co-ops Biggest Pitfall
Not To Engage

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PV Water Pumping for Livestock *as a Business*

- PV Systems
  - 12 systems sold
  - 22 systems leased
  - 5% stockwells PV
  - 1 off-grid home
  - 1 grid-connected home
- Northwest role
  - Point of contact
  - Knowledge base
  - Service

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PV Water Pumping for Livestock *as a Business*

- 1000+ windmills

Existing lines

  - 50-70 years old
  - 30-40 miles @ $12,000/mile

$*500K* long term value

Yearly maintenance

  - $150 newer lines/older ↑
  - $?? PV

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What Is Needed?
Co-op/Utility Knowledge Base

- Equipment- RUS
  - Specifications
  - Safety
- Design Capacity
  - Electric Lines/Overload
  - PV/No Reserve (minimize cost)
    - Factory/Dealer
    - Co-op/Customer
- Overall Project Knowledge by Co-op
  - NRCS - pipeline
  - PV Design/Sales
  - Rancher's needs
- Hardware - Efficiency
  - DC vs AC
  - Single Phase vs 3 Phase

What Is Needed?
Service

- Reliable Service (***If it doesn't work we fix it***)
- Infrastructure
  - Driller
  - Co-op (inventory)
- Financing
  - Low interest rates
  - Longer depreciation
  - Revenue

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Some things we can fix!

Some things take a little longer!

What Is Needed?
Service

- Energy Efficiency
  - Irrigation Systems
  - Residential Systems
- Distributed Generation
  - What to do.
  - What not to do.
- Properly Designed/Integrated DG Systems provides value
  - Distribution System
  - Customer

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What Is Needed? Partnerships

- Northwest
  - Overall Project PV Design/Sales
  - Farmer/Rancher /Homeowner Needs
  - Safety
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  - System Engineering
  - Technical Base
- Rural Utility Service
  - 'List of Materials'
  - http://www.usda.gov/rus/electric/listof.htm
- Industry
  - System Design
  - Product
- *Understand Costs*
  - O&M Records
  - What Lasts?/What Doesn't
  - Cost?

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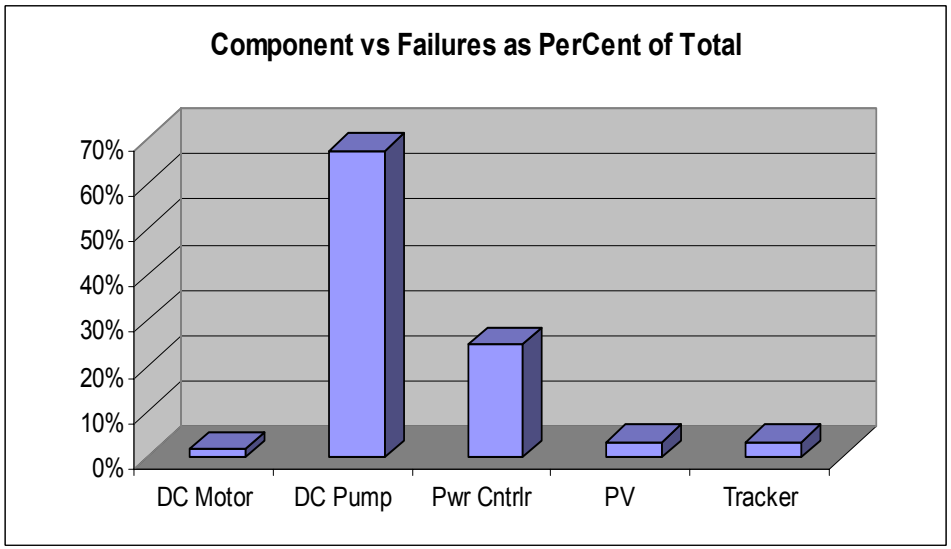
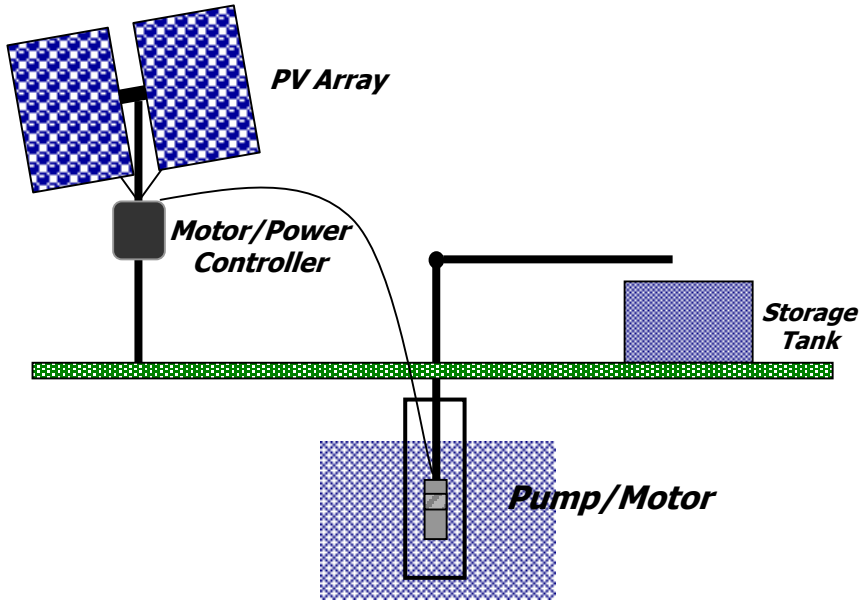
Water Pumping--Components and Associated Unscheduled Maintenance



Source: 28 installed systems (CY1990-2000), 61 reported failures
Northwest Rural Public Power District, Hay Springs, NE



Observations:

- ⇨ 'DC Pump' failures about 2/3 of events
- ⇨ 'Unknown' failures (insufficient details for failure identification) comprised almost 90% of the reported failures
- ⇨ Power Controller ('Pwr Cntrlr') comprised about 1/4 of failures
- ⇨ 'PV Array' maintenance-1 Unk/1 Sizing

Comments:

- ⇨ Infrastructure for maintenance will minimize some of these problems
- ⇨ PV failure was module related
- ⇨ Unknown failures (insufficient details for analysis) indicate the need for improved diagnostic reporting
- ⇨ DC Pump continuing problem
- ⇨ Manufacturer support critical need
- ⇨ AC systems desirable-OTS motors/pumps available with proven reliability

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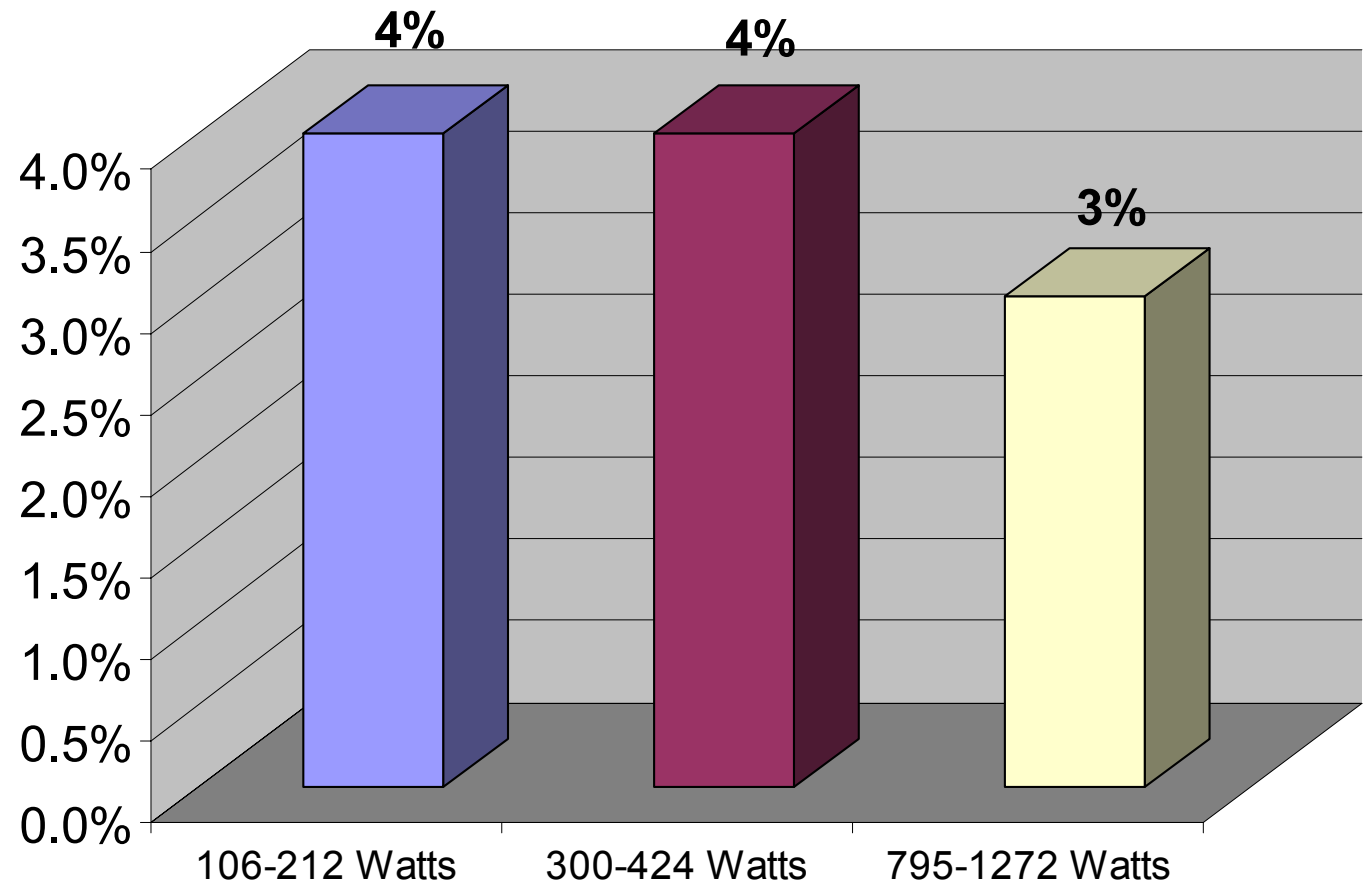
Annual Maintenance Cost (Parts+Labor+Travel) as Per Cent of Initial System Cost



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Source: 28 installed systems (CY1990-2000), 74 reported failures
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Distribution Lines

	1. Construction/O&M Cost			
		$12,000	Construction cost per mile	
		$200	O&M per mile per year	
	2. Financing Criteria			
		5%	Per Cent Loan	
		30	Year Loan	
	3. Monthly Recovery			
			Est	
		Distance	Monthly	
		(miles)	Recovery	
			Rate	
		3	$243.22	
		2	$162.15	
		1	$81.07	
		0.5	$40.54	$26.50

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Water Pumping Systems

What do you have at the end of each year?

	Pump/Motor, Power Controller, PV, Travel & Labor included		
	1024 W	300 W	150 W
System Cost	$11,589	$4,281	$1,530
Annual O&M cost	4%	4%	4%
O&M Yearly	$464	$167	$61
Financing 5%, 15 years			
Finance Yearly	$1,100	$397	$145
Northwest Monthly Fee	$145	$66	$35
Recover Yearly	$1,735	$791	$415
Yearly Margin	$171	$227	$209

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Photovoltaic Leasing Rate

Customer:	Wagonwheel Ranch				
Number of PV Panels:	4				
Monthly Payment:	$22.83				
	Unit Cost	Expected Life	Monthly Cost	Qty	Monthly Payment
Service Charge					$2.50
PV Panels/Harness	$400.00	20	$3.22	4	$12.88
Power Controller	$256.00	5	$5.13	1	$5.13
2 P. M. Brackets	$80.00	30	$0.56	0	$0.00
6 P. M. Brackets	$115.00	30	$0.80	1	$0.80
10 P. M. Brackets	$135.00	30	$0.94	0	$0.00
Trailer – 4X7	$425.00	20	$3.42	1	$3.42
Trailer – 6X8	$560.00	20	$4.51	0	$0.00
Maintenance Cost					
Per Panel	$0.15		$0.60	4	$0.60
Total					$22.83

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Summary

✓ PV can be a *positive* and valuable addition to a utility's portfolio of options for service to its customers.

✓ PV is *cost effective* at site-specific locations today, with many additional opportunities created by energy price spikes.

✓ Utilities are a *critical partner* in renewable energy applications.

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As Partners, We Can Continue to Improve the Quality of Life in Rural America

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